

5-100 GENERAL

Sampling and testing on roadway construction projects ensures that materials and construction methods conform to plans and specifications. The contractor and Resident Engineer should discuss the appropriate corrective actions when materials or construction methods do not conform to the plans or specifications. This section describes sampling and testing guidelines.

Consistent sampling and testing procedures are necessary for quality public works projects. In response to the federal government's goal of improving the quality of transportation projects, local, regional, and state public works agencies in Nevada established the Nevada Alliance for Quality Transportation Construction (NAQTC) program. An association of western states has a similar testing qualification program called the Western Alliance of Quality Transportation Construction (WAQTC). If an individual is WAQTC qualified and is American Concrete Institute (ACI) qualified, NDOT accepts the qualifications in lieu of the NAQTC qualification.

Field testers are required to be NAQTC qualified by successfully passing written and performance examinations. Even though NDOT requires NAQTC qualification for all field testers, field testers should be familiar with these specifications and perform all NDOT tests according to the designated test method.

If your project is metric and you need help with metric units, call the Construction Office, Quality Assurance Section (775-888-7226).

5-200 FIELD SAFETY

All sampling, testing and equipment operations will adhere to the safety requirements of Federal and State Occupational Safety and Health Administration (OSHA) standards and Federal and State Mine Safety and Health Administration (MSHA) standards, which can be found at www.osha.gov/SLTC/etools/construction/shprogram.html and www.msha.gov/Accident_Prevention/minetypes.htm.

Testers will adhere to the following safety requirements:

- General:
 - Wear seatbelt while in vehicle
 - Secure testing equipment in vehicle
 - Use strobe light and blinkers when pulling in and out of lane closure
 - Do not park amongst or behind contractor's equipment; keep vehicle visible to equipment operators
 - If parking next to live traffic, remember where traffic is located
 - Wear proper safety gear, such as boots, vest, hat, or hard hat
 - Follow OSHA and MSHA safety procedures

- Trenches:
 - Confirm contractor uses shoring for any vertical wall four feet or higher
 - Confirm contractor shores above the vertical wall
 - Confirm the contractor uses proper ventilation in trench
 - Provide a safe way to lower and raise testing equipment in and out of trench, such as a rope and pulley
 - Contractor must provide access in and out of trench every 25 feet for every worker
 - Coordinate to make sure somebody observes from outside of trench until tester is completely out of trench
- Concrete:
 - Do not set up testing equipment where equipment will be operating
 - Set up equipment with an escape route in mind
 - When sampling from a concrete truck:
 - Make sure truck is parked with parking brake set
 - Make sure driver is out of truck
 - Notify driver that you are taking a sample
 - Notify driver when sampling is completed
 - Listen for back-up alarms and be aware of your surroundings
 - Wear high visibility clothing
 - Use proper lifting techniques when lifting
 - Clean testing site between samples to prevent tripping hazards
- Plantmix Bituminous Mixes:
 - Do not stand in front of paver
 - Wear gloves when taking sample
 - Wear high visibility clothing
 - Use proper lifting techniques when lifting
 - Do not cross windrow directly in front of paver
 - Let paving operator know you are taking samples
 - Be aware of rollers and other equipment in all directions
 - Be aware of traffic passing the work site

- Stockpiles:
 - Before taking sample, inform loader operator of location of samples
 - Listen for back-up alarms
 - Do not climb stockpiles without knowing what is under stockpile
 - Do not climb or stand under stockpiles that have vertical faces
 - Use proper lifting and carrying techniques when moving sample
 - Do not run out from behind a stockpile; equipment could be working on the other side
- Belt sampling:
 - Use lock out and tag out procedures when sampling from the belt
 - If belt sample is required, use a ladder or stairway with hand rails to access belt
 - Use fall protection gear if hand rails are not present
 - If a safe platform with handrails is not available, let qualified contractor personnel take samples; observe to confirm that the samples are properly obtained
 - If a situation is unsafe, do not take sample; let NAQTC or WAQTC qualified contractor personnel take sample
 - Provide a safe system to transport sampling equipment to and from the belt, such as a pulley system
 - Use proper lifting and carrying techniques
- Sampling device:
 - Be sure pinch points are covered to prevent injury
 - Inform plant operator when you take a sample
 - Ensure safe access to sampling device
 - Ensure a safe system to get sampling equipment to sampling device
 - Use proper lifting and carrying techniques

The Resident Engineer will ensure field labs are properly equipped with the following safety items:

- Regulatory signs, all-in-one labor law poster, with current minimum wage.
- Insurance Certificate showing dates of coverage and policy number for Workers Compensation and the Workers Compensation and Insurance Rights Poster.
- Department Safety Manual.
- Emergency evacuation plan with emergency telephone numbers on the wall. (Update each time the lab trailer moves to a new location.)
- Fire extinguishers. Each crew is responsible for checking extinguishers for adequate charge and verifying they are free of leaks. Inspect extinguishers monthly; initial and date the monthly date card. Recharge fire extinguishers annually.
- First aid kit with CPR mask and gloves.
- Eye wash station. The crew must check monthly for leaks in eye wash solution. Record the inspection on the initial and date card. Change eye wash solution every six months. CAUTION: Eye wash solution is susceptible to freezing; therefore, empty it if temperatures in the lab reach below freezing.
- Hazard Communication/Material Safety Data Sheets (MSDS) Manual. Each crew is responsible for updating and maintaining its MSDS Manual for each project. Field labs are required to have an MSDS Manual on site.

Field testers should follow the following lab safety guidelines:

- Use gloves and wear long sleeved clothing when handling hot equipment or samples
- Wear safety glasses or face shield when necessary
- Wear hearing protection
- Shake pycnometer jars at chest level, not in front of face
- Use proper lifting techniques
- Clean the lab when testing is completed to prevent tripping hazards
- Maintain lights in and out of lab
- Keep stairways and doorways clear and free of debris
- Keep fire extinguisher current and ready
- Keep eye wash station clean and clear of debris; change fluid as required
- Keep ground outside of lab clean and free of debris
- Keep lab shed clean and free of debris

5-300 TESTER QUALIFICATION PROGRAM

To improve the quality of materials and construction operations on transportation projects, the NAQTC qualification program was developed. All staff performing field testing on NDOT construction projects must be NAQTC qualified. Although the University of Nevada, Reno (UNR) administers the NAQTC program, NDOT manages the program for NDOT field testers. For additional information refer to NAQTC website at www.naqtc.unr.edu.

NAQTC qualification is valid for five years. The Qualified Technician Registry (<http://www.naqtc.unr.edu/techregistry.html>) lists individuals qualified under the NAQTC program. Qualified individuals receive identification cards with personal information on the front and qualification information on the back, indicating fields of qualification and expiration dates.

The NDOT qualification program requires that testers successfully complete the modules in the areas where they will perform tests. Although the NAQTC program contains six modules, NDOT requires qualification in only the first four areas listed below.

- Sampling and Density (SD)
- Aggregate (AG)
- Asphalt (AS)
- Concrete (NAQTC does not test for concrete qualification. Instead, it requires American Concrete Institute [ACI] Concrete Field Testing, Grade I Technician certification.)
- Asphalt Extended (AE)
- Specialized Tests (ST)

Each module has a written and a performance examination requirement. With the exception of ACI, the applicant must pass the written exam before taking the performance exam. NAQTC grants qualification upon successful completion of both examinations.

5-301 APPRENTICESHIP

To gain field experience after successfully completing a written exam, an individual may perform testing under the direct supervision of an NAQTC qualified tester. The supervising NAQTC tester may be an NDOT tester or a consultant tester. An exception to this apprentice supervision is when an NSOT apprentice is operating a nuclear density gauge. When an NDOT apprentice is operating a nuclear density gauge, the NDOT apprentice must be supervised by an NDOT NAQTC qualified tester. The NAQTC tester and the apprentice both sign test reports. Under the supervision of a qualified tester, the tester who has not yet completed the performance exam gains experience in performing field tests. This tester is defined as an apprentice tester. The apprentice then becomes NAQTC qualified by passing the performance exam within one year of successfully passing the written exam. Refer to the *Administration Manual* at the NAQTC website at www.naqtc.unr.edu for details on the apprenticeship and qualification program.

5-302 REGISTRATION PROCEDURES

Each Resident Engineer must notify the Construction Division Quality Assurance Section of personnel to send through the NAQTC qualification program. The notification includes the following information:

- Individual's name
- Modules to be taken
- Type of test (written or performance)
- Requested dates
- Requested testing location

The Construction Division Quality Assurance Section will administer the applications. Each candidate for the performance exams must fax a signed copy of the "Rights and Responsibilities Agreement" to the Construction Division office (775-888-7210) and mail the original.

Refer to the UNR Web site (<http://www.naqtc.unr.edu/>) for the Qualified Technician Registry, the *NAQTC Handbook/Administrative Manual*, and the Exams Calendar/Results.

5-303 TESTER RESPONSIBILITIES

Qualification carries inherent rights and responsibilities. These responsibilities include performing and reporting test results with accuracy and precision expected of the technician in accordance with the required NDOT test procedures outlined in the "Synopsis of Materials Division Testing Manual for Field Testing." Failure to follow the field testing manual may result in suspension from testing duties, or other penalties, including termination of employment.

Each tester must sign the NDOT Responsibilities Agreement for Field Testing form, which follows this page. Additionally, NAQTC requires each tester to sign an NAQTC rights and responsibility agreement. The NAQTC rights and responsibility form is unique to NAQTC and can be found at <http://www.naqtc.unr.edu/>. Each tester is responsible for completing the form prior to attending the NAQTC performance exam.

5-400 MATERIALS TESTING

The two principal testing categories on NDOT construction projects are acceptance testing and informational testing. The majority of tests performed by the project laboratory are acceptance tests of construction materials. Acceptance testing is required to determine conformance with the specifications. All other tests are considered informational tests.

5-401 TESTING AND SAMPLING FREQUENCIES

Table 5.1 (at the end of this section) presents the required minimum frequencies for sampling and testing for materials commonly used in roadway construction. Sampling frequencies shown are the minimum requirements under ordinary conditions. The sampling frequency may be increased to ensure adequate control. Sampling requirements may vary on some projects according to unique conditions. For off-system projects, the Resident Engineer may waive the "per day" frequencies. Discuss any changes from the frequencies shown in Table 5.1 with the Quality Assurance Engineer. Refer to the Materials Checklist Letter, which the Materials Division distributes for each project, for materials that are either not listed in the table or require alternate sampling instructions. Except as provided in Subsection 106.05 of the specifications, all materials are inspected, and/or tested for acceptance before incorporating into the work.

Table 5.2 presents the required sample weight, based on the size of the aggregate size sampled, for source acceptance. Source acceptance is described in Section 5-402, Source Acceptance Sampling and Testing. Table 5.3 presents the required sample weight for field testing (acceptance testing and informational testing).

Table 5.2 – Sample Size Nev. T200 Source Acceptance

(The size of the source acceptance of processed material depends on the nominal maximum size of the particles according to this table.)

Nominal Maximum Size Of Particles *	Minimum Weight of Field Samples
Sieve Size	Kilograms (Pounds)
90 mm (3 1/2 in)	75 kg (150 lbs)
75 mm (3 in)	60 kg (125 lbs)
63 mm (2 1/2 in)	50 kg (100 lbs)
50 mm (2 in)	45 kg (90 lbs)
37.5 mm (1 1/2 in)	35 kg (70 lbs)
25 mm (1 in)	25 kg (50 lbs)
19 mm (3/4 in)	15 kg (30 lbs)
12.5 mm (1/2 in)	10 kg (20 lbs)
9.5 mm (3/8 in)	5 kg (10 lbs)
4.75 mm (No. 4)	5 kg (10 lbs)
2.00 mm (No. 10)	5 kg (10 lbs)

*For purposes of this test method, "Nominal Maximum Size of Particles" is defined as the smallest sieve that will pass at least 90 percent of the sample.

Table 5.3 – Sample Size Nev. T206 Field Samples

(The size of the field samples of processed material depends on the nominal maximum size of the particles according to this table.)

Nominal Maximum Size Of Particles Aggregate Size	Minimum Dry Weight of Field Samples Grams
100 mm (4 in)	Discretion of Resident Engineer
90 mm (3 1/2 in)	30,000 g
75 mm (3 in)	25,000 g
63 mm (2 1/2 in)	20,000 g
50 mm (2 in)	15,000 g
37.5 mm (1 1/2 in)	9,000 g
25 mm (1 in)	3,000 g
19 mm (3/4 in)	2,500 g
12.5 mm (1/2 in)	1,500 g
9.5 mm (3/8 in)	1,000 g
4.75 mm (No. 4)	500 g
2.36 mm (No. 8)	250 g

*For purposes of this test method, "Nominal Maximum Size of Particles" is defined as the smallest sieve that will pass at least 90 percent of the sample.

Samples of aggregate for tests are prepared from field samples by quartering or other suitable means to ensure a representative sample.

5-402 SOURCE ACCEPTANCE SAMPLING AND TESTING

5-402.1 GENERAL

On most NDOT construction projects, available sources of aggregate (also referred to as "material site," "a pit," or "a deposit") are made available in the plans and specifications. The Materials Division investigated and identified these material sites. In some situations, the contractor may want to use another site, or expand the limits or boundaries of an approved site. When this situation occurs, the Resident Engineer should contact the Materials Division for guidance. Before an alternate or expanded site is accepted for use by the contractor, the Materials Division may require the Resident Engineer to collect samples and perform informational tests. After the Resident Engineer performs informational testing, the Resident Engineer sends samples to the Materials Division. The Materials Division performs acceptance tests to determine if the source is acceptable for use. Allow sufficient time to accomplish any additional sampling and testing by the Resident Engineer and to obtain approval and written authority from the Materials Division.

5-402.2 SAMPLING MATERIAL DEPOSITS

Typically material sites are sampled at locations selected by Materials Division personnel. Excavate the test holes as deep as possible or until bedrock is reached to characterize the native material. Use a 200 by 300 foot grid when sampling a material deposit.

Follow this procedure to obtain samples from test holes:

1. Obtain a sample of each layer or strata of material observed by channeling the face vertically with a shovel or similar device. Take a separate sample of the overburden in each test hole.
2. Obtain a sample from the floor of the test hole after carefully removing all loose material to prevent contamination.
3. Obtain a composite sample of material from the sides of the test hole, excluding overburden and bottom, in the same proportions as present in the excavation. One way to accomplish this is to channel each layer the same width, such as a shovel blade width, for the full depth of the hole.
4. Ensure that the size of each of the above samples is not less than 25 pounds for sand sizes and 150 pounds for gravel up to three inches in size, when in layers over three feet deep. For layers of gravel less than three feet deep, 75 pounds is a sufficient sample size. Estimate the proportions of 3-inch to 6-inch material and plus 6-inch.
5. Identify and log each test hole as follows:
 - Test Hole Number – usually assigned in the order sampled
 - Depth of overburden
 - Depth of each layer sampled
 - Percentages of oversize material not sampled
6. Identify each sample as follows: (example of Test Hole #1)
 - Overburden sample if present: #1 O.B.
 - First layer beneath overburden: #1
 - Second layer: #1A
 - Third layer: #1B, etc.
 - Bottom of test hole: #1 Btm.
 - Composite sample: #1 Comp.
7. Survey the pit and make a sketch showing the location of all test holes and the distance from the center of the pit to the centerline of the roadway.
8. Stake all test holes for identification.
9. Submit a location sketch, log of holes, and samples to the Materials Division for testing.
10. Testers may use the field laboratory to determine plasticity or other critical properties. However, take samples in the manner described above.

5-402.3 SAMPLING STOCKPILES

Use the following procedure when sampling existing stockpiles. For those stockpiles that the contractor is developing, collect the samples during stockpile construction. Table 5.1 (at the end of this section) provides the minimum frequencies required for sampling.

1. Sample at the top, middle, bottom, and around the circumference. Do not sample exposed material. Be aware of the segregation that usually occurs when material is stockpiled, with the coarser particles rolling to the outside base of the pile.
2. Test separate samples individually, if desired, to show the extent of variation in the stockpile.
3. Combine separate samples, if desired, to form a composite sample to show the overall quality of the stockpile.
4. When possible, use power equipment to expose various levels of the stockpile.
5. Push a board into the pile above the sampling point to help prevent further segregation during sampling.
6. Refer to Tables 5-401.2 and 5-401.3 for sample sizes.

5-402.4 SAMPLING FOR BITUMINOUS MIX DESIGN

Follow these procedures before sampling stockpiles for a mix design:

1. Sample all stockpiles at the same time
2. Verify that stockpiles contain the minimum required tonnage according to the specifications
3. Confirm that the contractor provides the bin percentages to the Resident Engineer, based on the contractor's testing results

The Materials Division performs mix designs for dense-grade and open-graded plantmix. The Resident Engineer's field tester collects aggregate samples for these tests and transports them to the Materials Division. These samples must be accompanied by the field test results, which show that the aggregate samples meet specifications for sieve analysis, liquid limit, plasticity index, fractured face, and absorption. In remote areas that require long transport times for sample delivery, testers can perform the field tests while the split samples are being transported. The Materials Division must receive the field test results by fax or e-mail before the samples arrive.

Completely fill out mix design sample transmittals, including the contractor's proposed bin percentages and asphalt source and type. Attach test results to the transmittal. The transmittal form must be completely filled out and signed by the Resident Engineer or Assistant Resident Engineer. The transmittal must show the source of the material, not necessarily where it is currently stockpiled. For example, if the material originated from Blue Diamond Pit, then was hauled and used at Sunset Plant, the source of the material is Blue Diamond Pit. Incomplete or inaccurate information on a transmittal can cause delays in obtaining a mix design.

When sampling stockpiles, make sure samples represent the whole stockpile. Also make sure that stockpile names are consistent for all sample submittals from the same stockpile. For example, concrete sand, sand, natural sand, and natural fines should not be used to describe the same stockpile.

A stockpile should have only one name. Verify the names of stockpiles with the contractor, ensuring that the contractor and NDOT use the same stockpile name. Per Section 106.08 of the specifications, the Resident Engineer may be required to label stockpiles.

5-402.5 FIELD TESTING FOR SOURCE ACCEPTANCE

Field testers should run informational tests to verify material will meet project control requirements before submitting for Materials Division source acceptance. The Materials Division normally tests for the source acceptance of concrete aggregate. When exceptions to this occur, the Materials Division will request field samples to be taken in accordance with the instructions provided by the Materials Division and the procedures outlined in this manual. Once the Materials Division accepts a source, the Resident Engineer may be asked for additional testing and sampling to verify the continued quality of the materials from a source.

5-402.6 MATERIALS DIVISION TESTING FOR SOURCE ACCEPTANCE

The Materials Division identifies all required testing for source acceptance, performs the tests, and provides all test results to the Resident Engineer. The specifications describe the conditions under which the source is accepted. Occasionally, the Resident Engineer and the field testers may be involved in source acceptance testing. If additional information is needed, the Resident Engineer should contact the Materials Division.

5-403 INFORMATIONAL TESTING

5-403.1 INFORMATIONAL TESTING – NDOT

The following are examples of informational tests conducted by NDOT testers:

- Preliminary tests used for mix designs
- Preliminary tests made on borings or test hole samples during investigation of material deposits
- Samples of aggregate taken during stockpile production
- Moisture content
- Distribution of hydrated lime in marinated aggregate
- Compressive strength test on cement treated base mixtures
- Compressive strength of concrete cylinders other than the 28-day curing period, unless they are specified for acceptance
- Tests on any material taken before the specified acceptance point, as outlined in the specifications

All Independent Assurance (IA) testing is classified as informational, as these tests are used only to provide verification of the project control results and testing procedures. All testing will comply with testing standards, even if they are informational tests, and will be recorded in the appropriate logs, reports, and field books.

5-403.2 INFORMATIONAL TESTING – CONTRACTOR

Section 106 of the specifications describes the contractor requirements for informational testing. NDOT inspectors or field testers can monitor and observe contractor informational tests.

5-403.2.1 QUALIFICATIONS

The contractor's testers are required to be NAQTC qualified in the aggregate module or WAQTC qualified in the aggregate, and embankment and base modules. The contractor's personnel responsible for obtaining asphalt samples shall maintain qualification for AASHTO test T40 in the NAQTC Specialized Testing (ST) module. Testers must provide proof of qualifications to the Resident Engineer. The contractor's testers must also be approved by the IA lab. Tests performed by non-qualified personnel will be considered invalid and will not be included in the required frequency, as per Section 106.

5-403.2.2 CONTRACTOR QUALITY CONTROL TESTS

Contractor performs quality control tests on aggregate materials that are produced for incorporation into the work. Samples of materials are taken and tested on a day-to-day basis by the contractor's testing personnel. Sections 704, 705, and 706 of the specifications list the tests the contractor is required to perform. During production, the results of these tests must be submitted to the Resident Engineer daily. If materials originate from a commercial source, the contractor furnishes test results performed during production of those materials.

5-403.2.3 AUDITS

Per Section 106 of the specifications, the IA lab monitors and audits the contractor's testers. The IA lab testers will visually audit or split samples with the contractor personnel to verify they are completing the tests in accordance with NDOT's test methods. The Construction Division and the IA lab will determine the number of audits required per contractor based on past performance and knowledge of the contractor testers. All contractor informational tests are subject to visual or procedural audits by NDOT field and IA lab testers at any time.

5-403.2.4 REPORT FORMS

The contractor's testers should complete daily reports of test results for contractor informational tests each day the respective work is performed. The contractor is not required to use NDOT test report forms, but the same information that is on the NDOT test forms must be included on the contractor's report forms. The Resident Engineer shall receive the contractor's informational tests on a daily basis, as stated in Subsection 106.04 of the specifications. Original test reports are preferred but not always feasible for a commercial source, as the same test reports may cover several projects.

The office person and Resident Engineer will review the test reports and return any errors or omissions to the contractor for corrections. The Resident Engineer will submit originals or copies of the contractor's test reports to the appropriate District IA lab. The IA lab will review the tests reports and return any errors or omissions to the Resident Engineer for the contractor to correct. Upon satisfactory completion, the IA lab will forward the contractor's test reports to the Construction Division.

5-403.2.5 FILES AND RECORDS

The contractor's lab should maintain copies of all field test reports for contractor informational tests. Staple worksheets with the contractor testers' handwritten initials to each report and file them chronologically by the type of material.

The Resident Engineer will maintain a file for contractor informational test reports.

5-403.2.6 EQUIPMENT

For the required tests, contractor labs should have the same or comparable equipment to NDOT field labs. Deviations from standard testing equipment must be coordinated in advance with the Construction Division.

5-403.2.7 LAB EQUIPMENT CALIBRATION

The contractor's lab equipment must be calibrated once a year or anytime the lab is moved. If questions arise, the Materials Division may assist with calibration of specific contractor equipment. Documentation of the calibration must be kept in the lab for review by the Resident Engineer.

5-404 PROJECT ACCEPTANCE TESTING (FIELD TESTS)

5-404.1 GENERAL

Acceptance tests are the tests conducted at the appropriate locations and times, using methods prescribed in the specifications. Table 5.1 (at the end of this section) lists acceptance tests and frequencies. Tables 5.2 and 5.3 lists sample sizes. The Materials Checklist Letter provided by the Materials Division identifies materials acceptance details for each project. Subsection 5-406, Field Office Record Keeping, outlines specific requirements for reporting test results. The remainder of this section of the *Construction Manual* provides additional instructions.

Project acceptance tests control the quality of the materials being incorporated or proposed for incorporation into the work. Field tests provide the basis for accepting materials incorporated into the project.

5-404.2 FIELD LABS AND TESTING EQUIPMENT

The field labs belong to the Equipment Division and are assigned to the Construction Division. The Construction Division assigns testing laboratories, usually of the mobile "trailer" type, for field use. The Resident Engineer uses and maintains these lab trailers and the equipment assigned to the lab.

5-404.2.1 LAB SETUP

Verify that the lab has water, gas, and electricity. The lab must be sufficiently stabilized to provide satisfactory footing for digital scales, sand equivalent apparatus, and other sensitive equipment. The contractor must provide the utilities for the labs per Section 628, Mobilization, of the specifications.

5-404.2.2 RESPONSIBILITIES

Obtain small testing equipment and certain testing supplies by requisition from the Headquarters Stockroom or a District Stockroom. Contact the Construction Division Quality Assurance Section for a list of equipment and supplies normally needed in a field lab. The Resident Engineer should obtain incidental supplies such as wheelbarrows, shovels, pliers, screwdrivers, and wrenches through the appropriate stockroom. For equipment not available through the stockrooms, the equipment and supplies may be obtained through the District IA Lab or Construction Division Quality Assurance Section.

The Resident Engineer requests equipment over \$1,000 in the annual budget request to the District Engineer. If the District and the Construction Division approve the budget, the Construction Division purchases the equipment and distributes it accordingly. For equipment purchases under \$1,000, the Resident Engineer submits a request to the District Engineer. The District and Construction Division must approve the request.

The Independent Assurance (IA) lab assigns Troxler Nuclear Density Gauges to construction crews on an "as needed" basis. The Resident Engineer is responsible for security, use, transportation, and care of this equipment during the assignment period. Use exceptional care in handling this equipment, especially while transporting it. Further information and guidance on the Nuclear Density Gauges is in Section 5-500, Nuclear Testing Program.

Only appropriate materials and equipment are authorized in the field lab. The Resident Engineer is responsible for enforcing this policy. No potentially offensive material (pictures, magazines, calendars, posters, etc.) is allowed in the field lab. The District Engineer is responsible for the security of the field lab and equipment when stored by the District. The contractor is responsible for the field lab security at the jobsite. Resident Engineer is required to contact the Equipment Division when the field lab needs to be moved. The Equipment Division will then schedule the move using Department or commercial movers. Coordinate with the Equipment Division to determine required preparation of the field lab and contents. The testers are responsible for stowing the equipment and supplies within the field lab.

5-404.2.3 INVENTORIES

An inventory of testing equipment for each lab trailer is conducted once a year, in June, and reported on NDOT form 040-020, "Inventory of Testing Equipment." Most of the testing equipment is assigned to a specific lab trailer and the trailer number appears on the inventory. Submit a property adjustment form, NDOT form 072-006, "Property Adjustment," before transferring testing equipment (property number items) from one trailer to another.

For equipment over \$1,000, the Construction Division Quality Assurance Section should schedule and complete inventories for the Purchasing Division once a year.

5-404.2.4 LAB CALIBRATION

The Materials Division is responsible for scheduling equipment calibration within the field labs. They will contact the Resident Engineer to schedule the annual calibration and accomplish the calibration at the field lab site. The Materials Division calibrates ovens and scales annually. Any time a lab is moved, the Resident Engineer must contact the Materials Division (775-888-7792) to recalibrate the equipment.

5-404.3 EQUIPMENT REPAIR, MAINTENANCE, AND REPLACEMENT

Regular preventive maintenance, which is limited to cleaning, is necessary to maintain the field lab equipment in satisfactory operating condition.

Due to the manufacturers' guarantees and warranties and the sensitivity of the equipment, all personnel must strictly adhere to maintenance and servicing policies. Additional servicing or repair work of any kind is not authorized without prior approval from the Construction Division.

The Construction Division has personnel trained to repair equipment. Notify the Construction Division as soon as possible for the following equipment-related needs:

- Maintenance
- Repairs
- Removal of unnecessary equipment

This may include contacting District personnel for repairs to the field lab or contacting the IA lab or Construction Division to repair or replace equipment.

5-404.4 RETESTS

The following procedures apply to the retesting of materials that do not comply with the specifications. If the contractor disputes the test results, the first retest of unacceptable material should determine if the sampling and testing methods were correctly performed. If the retest produces similar results, the contractor should use an appropriate method to correct the unacceptable material.

Before completing further retests, the Resident Engineer should make sure that the contractor made a constructive effort to correct the unacceptable material. In the absence of corrective measures by the contractor, repetitive testing in an effort to get a passing test should not be allowed. Number retests according to the instructions in Section 5-406, Field Office Record Keeping.

For materials that fail to meet specifications but are incorporated into the work, the Resident Engineer must complete NDOT form 040-076, "Acceptance Test Summary Sheet," when the project is complete. Field testers track failing test results in the appropriate material field book by circling the failed test result in red, as described in Section 5-405, Field Office Record Keeping. Test results should be recorded in the field book daily. After the project is complete, the Resident Engineer completes an "Acceptance Testing Frequency Report," which summarizes all materials tested on the project.

5-404.5 MISCELLANEOUS SAMPLES AND TESTS

The Construction Division, District Engineer, or Federal Highway Administration (FHWA) may request that field testers sample and test materials or work that may be in question. Record these tests according to the instructions in Section 5-406, Field Office Record Keeping. .

5-405 FIELD OFFICE RECORD KEEPING

5-405.1 REPORT FORMS

Complete daily reports of test results the day the respective work is performed. Refer to Table 5.4 for the required report forms for various materials and tests. The Resident Engineer's office person checks the test reports. The Resident Engineer then reviews and signs the test reports. The Resident Engineer's signature confirms that the test results are accurate and completed in accordance with NDOT procedures. Once the test reports are completed, distribute them as detailed in Chapter 27 of the *Documentation Manual*.

Distribute all test reports within seven calendar days of test completion. Submit original field test reports to the appropriate District IA lab. The IA lab will review the tests reports and return any errors or omissions to the Resident Engineer for corrections. Upon satisfactory completion, the IA lab will forward the original test reports to the Construction Division.

Immediately notify the contractor of the preliminary test results. Give the final test results to the contractor as soon as possible but no later than seven calendar days after the test is completed.

Table 5.4 – Required Report Forms

Form Number	Report and Use
040-004	"Compaction Report" Relative Compaction of all construction materials
040-007 * 040-026 * 040-004	"Nuclear Compaction Report for Soils and Aggregates"
040-010 * 040-013 * 040-014 * 040-023 * 040-023A	"Daily Report of Tests Made in Field" Select Borrow Backfill Selected Material or Base Drain Backfill Aggregate Base Courses Screenings Sand Blotter Plantmix Aggregate Informationals Open-grade Aggregate Informationals (Aggregate stockpiles other than concrete)
040-011 * 040-050 * 040-053	"Daily Plant Report of Asphalt Mixtures" Plantmix Bituminous Base Plantmix Bituminous Surface Plantmix Bituminous Open-Graded Surface
040-016	"Report of Tests of Portland Cement Concrete Pavement" Flexural Strength Beams
040-017 * 040-017A * 040-017B * 040-030 * 040-048	"Nuclear Thin Layer Compaction Report for Plantmix Bituminous Pavements" Density on Bituminous Mix Pavements
040-035 * 040-013 * 040-006 * 040-023	"Report of Field Tests of Coarse and Fine Aggregate for Concrete" Concrete Pavements Concrete Structures
040-051	"Field Report of CTB Strength Tests" Plantmixed CTB Roadmixed CTB

* If required

5-405.1.1 COMPACTION REPORTS

Consecutively number compaction tests for a particular type of material for all sources. Code compaction tests as follows:

1. The first numbers represent the test number.
2. The next group of letters indicates the material used.
3. The next group of numbers indicates the minimum compaction requirement.
4. When retests are required, the fourth set of digits represents the retest number.

For example, if the test number is 218-S-95-2R, the code indicates test number 218, subgrade material, 95 percent minimum compaction as required by the specifications, and the second retest of the area represented by test number 218

Table 5.5 shows the codes to use for the different types of construction materials. It does not list special compaction requirements. Use of additional coding must be approved by the Construction Division Quality Assurance Section.

Table 5.5 – Construction Material Codes

Type of Material	Code	Specification Reference
Original Ground	OG	203.03.15
Subgrade (includes Roadway Excavation and Common Borrow in the Embankment)	S	203.03.15
Select Borrow	XB	203.03.15
Pipe Backfill	PB	207.03.01
Structure Backfill	SB	207.03.01
Foundation Fill	FF	208.03.01
Drain Backfill	DB	209.03.01
Type 1, Class B Aggregate Base	1B	302.03.06
Type 2, Class B Aggregate Base	2B	302.03.06
Type 3, Class B Aggregate Base	3B	302.03.06
Type 1, Class A Aggregate Base	1A	302.03.06
Type 2, Class A Aggregate Base	2A	302.03.06
Type 3, Class A Aggregate Base	3A	302.03.06
Portland Cement Treated Base	CTB	304.03.05
Roadbed Modification	RBM	305.03.05
Mechanically Stabilized Earth Backfill	MSE	640.03.02

5-405.1.2 NDOT REPORT FORM 040-010, "DAILY REPORT OF TESTS MADE IN FIELD"; 040-051, "FIELD REPORT FOR CTB STRENGTH TESTS"; AND 040-052, "DAILY REPORT FOR CTB MIXTURE"

Consecutively number reports for a particular type of material for all quantities obtained from each deposit (source). Consecutively number each of the two types of samples, informational or acceptance, on a daily basis.

Code test numbers as follows:

1. The first letter is "T" for acceptance test or "I" for informational test.
2. The second set of numbers represents the daily test number.
3. The third set of numbers represents the report number.
4. When retests are required, the fourth set of numbers represents the retest number.

The following are examples of test code numbers:

- Acceptance Test Number T-1-31 represents the first test taken at the acceptance point on Report Number 31.
- Acceptance Test Number T-1-31-R2 represents the second retest, taken at the acceptance point, of material previously tested and pertains to Acceptance sample number 1, Report Number 31.
- Informational Test Number I-1-31 represents the first informational test taken at the plant on Report Number 31.

5-405.1.3 NDOT REPORT FORM 040-035, "REPORT OF FIELD TESTS OF COARSE AND FINE AGGREGATE FOR CONCRETE"

Consecutively number reports for a particular type of material for all quantities obtained from each deposit (source) and for each mix design. Consecutively number each of the two types of samples, informational or acceptance, on a daily basis.

Code test numbers as follows:

1. The first letter is "T" for acceptance test or "I" for informational test.
2. The second set of numbers represents the daily test number.
3. The last set of numbers represents the report number.

The following are examples of test code numbers:

- Acceptance Test Number T-1-31 represents the first sample taken at the acceptance point on Report Number 31.
- Informational Test Number I-1-31 represents the first informational sample taken at the plant on Report Number 31.
- Acceptance Test Number T-1-29-2R represents the second retest, taken at the acceptance point, of material previously tested and pertains to Acceptance Sample Number 1, Report Number 29.

5-405.1.4 NDOT REPORT FORM 040-011, "DAILY PLANT REPORT OF ASPHALT MIXTURES"

Consecutively number reports for a particular type of asphalt mixture for all quantities obtained from each deposit (source). Consecutively number each of the two types of samples, informational or acceptance, on a daily basis.

5-405.2 FILES AND RECORDS

File copies of all field test reports in the field laboratory. Staple compaction retests to their corresponding original failing test. Keep summaries of all project acceptance tests in field books. These material summaries keep track of failing tests and areas to retest. They also allow quick access to test results and frequencies.

Number each page in the book 1 through 80 on the top right corner. Include a title page, a complete index, and an initial key, as shown in the following field book examples.

Submit all field lab books to the office when the project is complete.

5-405.3 FIELD BOOKS

This section addresses the following three required field books:

- Compaction Book
- Sieve Book
- Concrete Book

5-405.3.1 COMPACTION BOOK

Set up Compaction Books according to the examples in Figures 5-405.1, 5-405.2, and 5-405.3. Record remarks such as an audit, an occasional check of quantities placed, or addition of testing frequencies. Circle all failing tests in red so they can be identified quickly. Document each material in chronological order for test numbering.

Subgrade Compaction S-90								5		
Test #	Date	Tested by	Station	Embank Depth	Dist ft	% Comp	R-1	R-2	R-3	Remarks
1-S-90	6-10-06	J.T.	X' 108+10 RT	5'	10'	95				Full curve ran Audit by Peay Lab Contractor satisfied Area retest passed Area rechecked and retest passed. Audit by Peay Lab
2-S-90	6-12-06	J.T.	X' 120+00 LT	4'	12'	89	92			
3-S-90	6-21-06	SH	X' 105+92 RT	4'	11'	85	89	91		
4-S-90	7-1-06	J.T.	X' 115+10 RT	4'	10'	92				

Type I Class B Base Compaction (1B-95)								10		
Test #	Date	Tested by	Station	Embank Depth	Dist ft	% Comp	R-1	R-2	R-3	Remarks
1-B-95	7-7-06	J.T.	X' 90+89 RT	.5'	10'	95				Full curve ran used the gauge core used for gauge core used for gauge core used for gauge constant check used for gauge constant check Audit by Peay Lab
2-B-95	7-7-06	mjk	X' 94+75 RT	.5'	8'	96				
3-B-95	7-9-06	mjk	X' 92+00 RT	.5'	8'	95				
4-B-95	7-12-06	J.T.	X' 84+72 LT	.5'	10'	95				
5-B-95	7-14-06	mjk	X' 80+19 LT	.5'	8'	94	96			

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Figure 5-405.2. Compaction Book Example 2.

Type 2 FBS Compaction

Test #	Date	Tested by	Gauge Set #	C. F.	Station To Station	% Comp	Rice	Remarks
1-A-1 To 1-P-5	7-7-06	mkk	144	1.01	X' 25+100 To X' 25+77	95	155.9	Gauge Corr. W/ Notes Test Section Passed
2-P-1 To 2-P-5	7-8-06	mkk	144	1.01	R' 26+010 To L' 27+00	95	156.2	
3-P-1	7-8-06	mkk	144	1.01	R' 26+010 To L' 27+00	94	156.5	End of day small section
4-P-1 To 4-P-5	7-9-06	mkk	144	1.01	L' 98+30 To L' 105+50	94	156.9	

Select Borrow Compaction

Test #	Date	Tested by	Station	Embank Depth	Dist of	% Comp	R-1	R-2	R-3	Remarks
1-XB-95	5-12-06	SH	L' 20+19 RT	6'	12'	95				Gauge Corr. Prog. Lab. audit
2-XB-95	5-12-06	SH	L' 22+00 RT	6'	12'	97				Gauge Corr.
3-XB-95	5-12-06	SH	L' 24+00 RT	6'	13'	97				Gauge Corr.
4-XB-95	5-14-06	SH	L' 20+19 RT	6'	12'	96				Gauge Corr. check
5-XB-95	5-16-06	SH	L' 18+18 RT	6'	13'	95				Gauge Corr. check Contractor's Reviewed mat. Passed.
6-XB-95	5-17-06	SH	L' 14+00 RT	6'	11'	93	95			

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Figure 5-405.3. Compaction Book Example 3.

5-405.3.2 SIEVE BOOK

Keep summaries of project sieve analysis and other test results for aggregate materials in a field Sieve Book in the following manner:

1. Document each source in its own subsection. Divide each book into sections for each type of material. (Example: Type 1 Class B Aggregate Base, Type 2 Plantmix Bituminous Surface, Plantmix Bituminous Surface Open-Graded, Shoulder Material, Aggregate for Portland Cement Concrete Pavement, Concrete Aggregates)
2. Include the following in each section:
 - a. Test Identification – Consecutively list tests and identify each with the date and sample location. (Refer to Section 5-406, Field Office Record Keeping, for test numbering systems.)
 - b. Test Results – List numerical results of all acceptance tests; however, do not list sieve analysis results screen-by-screen. If all screens are in the specification, note the results as “P” (passing) or “F” (failing) and explain in the remarks.
 - c. Retests and Remarks – Include the date and test number of passing retests with an explanation of the corrective action taken.
3. List only acceptance tests in the Sieve Book. Keep summaries of informational samples in a separate book (Informational Book), if required by the Resident Engineer.
4. Figures 5-405.4, 5-405.5, and 5-405.6 show a sample page from the Type 1 Class B Aggregate Base, Type 2 Plantmix Bituminous Surface, Plantmix Bituminous Surface Open-Graded, Shoulder Material, Aggregate for Portland Cement Concrete Pavement, and Concrete Aggregates. Although other types of material will have different tests listed, follow the same basic arrangement for all materials.
5. Circle all failing tests in red so they can be identified quickly.

Type 1 C/S B Base (Sieves) 5

Test#	Date	Tested by	Station	Course	Grad P/F	L.L.	P.I.	F.F.	Remarks
T-1-1	4-1-06	J.T.	2" 102+50 LT	TOP WINDOW	P	24	2	92	Progress Lab Audit F.F. FAILED 14% Passing @ 200 Retest Passed
T-2-1	4-1-06	J.T.	2" 114+00 LT	TOP LT WINDOW	F	27	5	80	
T-2-1R1	4-2-06	J.T.	2" 114+00 LT	TOP LT WINDOW	P	22	2	93	
T-1-2	4-9-06	J.T.	2" 129+00 LT	TOP RT WINDOW	P	24	3	96	
T-1-3	4-10-06	J.T.	2" 149+00 LT	BOTTOM WINDOW	P	26	2	95	

Type 2 PBS (Sieves) 16

Test#	Date	Tested by	Mix Design#	Imp#	Gradation P/F	Station	Bit Ratio	Rice	% Moist	F.F.	Remarks
T-1-1	6-12-06	SH	BF06-12	1	D	5' 29+00 LT	4.85	155.1	.06	99	Stabilities Submitted
T-2-1	6-12-06	SH	BF06-12	1	P	5' 33+10 LT	5.00	155.1	.04	100	SPLIT w/progress lab
T-3-1	6-12-06	SH	BF06-12	1	P	5' 41+00 LT	4.90	153.7	.04	100	
T-1-2	6-19-06	SH	BF06-12	1	F	5' 31+00 RT	5.40	150.3	.02	100	Stabilities Submitted
T-2-2	6-19-06	SH	BF06-12	1	P	3' 62+12 RT	4.90	153.5	.02	100	

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Figure 5-405.4. Sieve Book Example 1.

3/8" Opengrade (Sieves) 27

Test#	Date	Tested by	Mix Design	JMP#	Gradation P/F	Station	Bit Ratio	% Comp	F.F	Remarks
T-1-1	7-25-06	SH	BF06-29	2	P	2* 10200LT	8.1	.03	100	
T-1-2	7-26-06	SH	BF06-29	2	F	2* 29700LT	8.9	.04	100	25% Pass #40 OUT OF SPEC OIL
T-1-3	7-27-06	SH	BF06-29	2R	P	2* 49700LT	8.2	.04	99	
T-1-4	8-9-06	J.T.	BF06-29	2	P	2* 72700LT	7.9	.02	100	

Shoulder Material (Sieves) 38

Test#	Date	Tested by	Station	Gradation P/F	PF	Remarks
T-1-1	3-13-06	J.T.	K' 7+29 LT	P	9	
T-2-1	3-13-06	J.T.	K' 17+31 LT	P	8	
T-1-2	3-17-06	SH	K' 29+30 LT	P	9	
T-1-3	3-18-06	JH	K' 30+01 RT	F	16	18% passing #200 12 max. P.I. got 16
T-1-3R1	3-18-06	SH	K' 30+00 RT	P	12	
T-2-3	3-18-06	SH	K' 10+05 RT	P	9	

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Figure 5-405.5. Sieve Book Example 2.

POCP Aggs (Sieve)						Mix # 3628				58
Test #	Date	Tested By	Coarse P/F	Fines P/F	Comp P/F	C.V.	SE	Fine mod	Base fine mod	Remarks
T-1-1	2-12-06	mk	P	P	P	73	85	2.99	2.99	
T-1-2	2-14-06	mk	P	P	F	89	89	2.60	2.80	** + #16 Failed on Combined
T-1-2R1	2-17-06	mk	P	P	F	86	88	2.87	2.83	** + #16 Failed cont Rem. stockpile
T-1-3	2-19-06	mk	P	P	P	91	91	2.71	2.80	

DA mod Sieves						Mix # 503				69
Test #	Date	Tested By	Coarse P/F	Fines P/F	CV	SE	Fine mod	Base fine mod	Remarks	
T-1-1	9-17-06	J.T.	P	P	85	82	2.51	2.51		
T-1-2	9-18-06	J.T.	P	P	91	81	2.60	2.56		
T-1-3	9-19-06	J.T.	P	P	92	83	2.57	2.56		

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Figure 5-405.6. Sieve Book Example 3.

5-405.3.3 CONCRETE BOOK

Set up Concrete Books according to the example Figure 5-405.7. Document audit remarks or occasional quantities checks. Circle all failing tests in red so they can be identified quickly.

PCCP Fresh Concrete (mix #3628) 5										
Set#	Date	Station	Slump	% Air	Unit weight	Beams	Temp	PSI	Tested by	Remarks
1	2-12-06	# at Plant	2.0"	5	127.7	—	71°F	4000	J.T.	Sample of cement & Fly Ash submitted
—	2-12-06	# at Plant	3.0"	6	127.6	—	71°F	4000	J.T.	
—	2-12-06	# at Plant	2.0"	5	127.3	1	71°F	4000	J.T.	
2	2-12-06	# at Plant	3.0"	5.5	127.6	—	70°F	4000	J.T.	
—	2-12-06	# at Plant	3.0"	5.5	127.6	—	70°F	4000	J.T.	

DA Mod Fresh Concrete (mix #503) 26										
Set#	Date	Station	Before Slump	After Slump	% Air	Unit weight	Temp	PSI	Tested by	Remarks
1	9-17-06	L* 27+91LT	1.0"	5"	6	129.2	71°F	3000	J.T.	
—	9-17-06	L* 28+21LT	1.0"	5"	6	—	70°F	3000	J.T.	
—	9-17-06	L* 28+56LT	1.5"	5"	6.5	—	71°F	3000	J.T.	
—	9-17-06	L* 28+91LT	1.0"	5"	6	—	71°F	3000	J.T.	
2	9-17-06	L* 29+26LT	1.5"	6"	7	130.2	71°F	3000	J.T.	
—	9-17-06	L* 29+61LT	1.5"	5.5"	6.5	—	71°F	3000	J.T.	

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Figure 5-405.7. Concrete Book Example.

5-405.4 TRANSMITTALS

When submitting samples to the Materials Division, verify that they are accompanied by the appropriate transmittal. Completely fill out transmittals. Incomplete and inaccurate transmittals may result in delayed test results. Refer to the Construction Division intranet site (SharePoint), <http://sharepoint1/040/default.aspx>, for copies of the transmittals. Following are the three transmittal forms:

- NDOT form 020-018, "Transmittal for Test Samples and Certifications"
- NDOT form 020-016, "Transmittal for Asphalt Samples"
- NDOT form 020-017, "Transmittal for Concrete Samples"

Following are the standard sample containers available from the Headquarters Stockroom:

- Aggregate and Stone: Sack, sample large cotton canvas, 19" x 32"
- Slurry Backfill, Plantmix Bituminous Surface and Portland Cement Concrete (when the maximum aggregate particle size exceeds 1"): Mold, cylinder plastic 6" x 12"
- Portland Cement Concrete for Structures: Mold, cylinder plastic 4" x 8"
- Liquid Asphalts: Can, rectangular metal, 1 quart, sample with lid
- Fly Ash, Hydrated Lime, and Portland Cement: first bag, sample polyethylene 10"x20" open end, place polyethylene bag inside a sack, sample small cotton canvas
- Water and Emulsified Asphalt: Bottle, plastic wide mouth with lid, 1 quart
- Asphalt Cement, Traffic Paint and Traffic Beads: Can, paint round 1 quart with lid

5-405.5 DISTRIBUTION

File copies of all field test reports in the field laboratory. At the end of each day, the tester forwards original test reports to the Resident Engineer. The office person and Resident Engineer will review the test reports. After review, the Resident Engineer retains a copy of the test report then submits original test reports to the appropriate District IA lab. The IA lab will review the tests reports and return any errors or omissions to the Resident Engineer to correct. Upon satisfactory completion, the IA lab will forward the test reports to the Construction Division. Chapter 27 of the *Documentation Manual* provides additional information on distribution of test reports.

5-406 TESTING PERFORMED BY OTHER DIVISIONS**5-406.1 MATERIALS DIVISION**

This section provides contact information for Materials Division testing performed in Carson City and Las Vegas. This section also lists the tests performed at each location. The Resident Engineer and field testers should direct their questions on field lab procedures to the appropriate lab.

5-406.1.1 AGGREGATE LAB

- Carson City (775-888-7791): Borrow, select borrow, aggregate base, backfill, granular backfill, MSE backfill, drain backfill, riprap, riprap bedding, top soil, screenings, deicing sand, plantmix bituminous surface aggregates, portland cement concrete aggregates
- Las Vegas (702-671-6646): Screenings, portland cement concrete aggregates

5-406.1.2 BITUMINOUS LAB

- Carson City (775-888-7872): Dense-graded and open-graded plantmix bituminous surface mix designs, dense-graded plantmix bituminous surface behind the paver samples
- Las Vegas (702-671-6628): Dense-graded plantmix bituminous surface behind the paver samples

5-406.1.3 STRUCTURAL LAB

- Carson City (775-888-7871): Concrete cylinders, reinforcing steel, tensioning strand, concrete aggregates, slurry backfill, concrete cores
- Las Vegas (702-671-6646): Concrete cylinders, reinforcing steel, slurry backfill, metal fence posts, guideposts, chain link fence, corrugated metal pipe

5-406.1.4 ASPHALT LAB

- Carson City (775-888-7879): Refinery samples, asphalt cement, bituminous emulsion, bituminous liquid
- Las Vegas (702-385-6579): Asphalt cement, bituminous emulsion, bituminous liquid

5-406.1.5 CHEMICAL LAB

- Carson City only (775-888-7718): Paint, traffic beads, water, hydrated lime, guideposts, metal fence posts, chain link fence, sign posts, corrugated metal pipe, wire mesh, fly ash, cement

5-406.1.6 PAVEMENT ANALYSIS SECTION

- Carson City only (775-888-7173): Final concrete pavement samples of portland cement concrete pavement

5-406.1.7 R-VALUE LAB

- Carson City only (775-888-7869): Borrow, select borrow, aggregate base, granular backfill, MSE backfill

5-406.2 STRUCTURES DIVISION NON-DESTRUCTIVE TESTING SECTION

5-406.2.1 STRUCTURAL STEEL

The Structures Division Non-Destructive Testing Section is responsible for the inspection and testing of structural steel construction. This section oversees the inspection and testing during erection, welding, and paint application to structural steel. This section is also involved in material certification reviews and visits steel fabrication plants to confirm compliance with specifications. The Resident Engineer coordinates closely with the Non-Destructive Testing Section and Materials Division to ensure inspection, sampling, and testing are accomplished as specified. The Structures Division may also request testing specific samples of structural steel from field sites. The Non-Destructive Testing Section inspector will mark the specific locations of the steel for testing and the contractor will provide that sample for the Resident Engineer to ship to the Materials Division for testing.

Following are general inspection areas for structural steel:

- Structural Steel Fabrication Inspection (includes bridges, column casings, signs, signal bridges)
 - Magnetic particle testing of welds and base metal
 - Dye penetrant testing of welds and base metal
 - Ultrasonic testing of welds and base metal
 - Visual inspection of welds and base metal
 - Radiographic interpretation of x-ray film of welds
 - Dry film paint thickness measurements
 - Bolt testing, field and shop
 - Mechanical tests on steel
- Post-tensioning and Prestressing of Concrete Structures
 - Observe and monitor stressing of tendons with pressure cell and strain gauge and measure elongation
 - Inspect rebar and strand placement in prestressed concrete members at fabrication shop
 - Perform flow cone test
 - Test concrete
- Ground Anchors
 - Monitor stressing of anchors with pressure cell and strain gauge and measure elongation

The Structures Division Non-Destructive Testing Section inspector will also collect samples of nuts, bolts, and washers and coordinate with Materials Division for testing. The Resident Engineer will coordinate with the contractor to make the required materials available.

5-406.3 MATERIALS DIVISION AND STRUCTURES DIVISION NON-DESTRUCTIVE TESTING SECTION

Testing and sampling for soil nail walls and mechanically stabilized earth (MSE) walls are specialized and systematic. Testing is done by the Materials Division and Structures Division Non-Destructive Testing Section. The Resident Engineer is responsible for coordinating the testing activities. The following information is a list of tests that aid in verifying conformance with specifications:

- Plasticity index
- Gradation
- Resistivity
- Chlorides
- Sulfates
- pH Value

Follow these guidelines when performing these tests:

- Obtain certifications from the contractor that meet the requirements of friction angle and magnesium soundness and send to the Materials Division.
- The Resident Engineer's inspector provides samples of Mechanically Stabilized Earth (MSE) backfill to the Materials Division.
- The Resident Engineer sends pile material certifications to the Materials Division for approval.
- Contact Structures Division Non-Destructive Testing Section at 775-888-7731 with any questions.

5-500 NUCLEAR TESTING PROGRAM

The information in this section provides important information relating to NDOT's Nuclear Testing Program and is not inclusive of all policies and procedures required for use of nuclear testing devices. Proper training, licensing, and qualifications are required before operating, storing, and transporting nuclear density gauges.

The Nevada State Health Division (Radiological Health Division), which enforces NRS 459.010, 459.290, and NAC 459, is the state radiation regulating and control agency and provides NDOT with its Radioactive Materials Licenses. NDOT has five licenses (Carson City, Elko, Reno, Winnemucca, and Las Vegas). The NDOT Construction Division is responsible for policies and procedures that are specific to NDOT construction operations and conducts mandatory training. NDOT policy and procedures authority resides with the Construction Office (775-888-7226). The District Radiation Safety Officer (RSO) is the first contact for any non-routine procedures and the first contact for any questions that may arise involving the Nuclear Testing Program and equipment.

NDOT does not allow pregnant women to test with, train with, or transport nuclear density gauges. Allowing anyone who is not certified by the Department to handle, transport, or store nuclear density gauges is a violation of state licensing requirements. State and federal regulations prohibit the storage of consultant gauges at or in NDOT facilities.

5-501 TRAINING AND SAFETY

To transport gauges, individuals must successfully complete a 4-hour class on nuclear density gauge safety. To transport and operate nuclear density gauges, individuals must pass a 40-hour class and then become NAQTC qualified in the Sampling and Density module. The 40-hour training class is divided into two parts: Radiation Safety and Gauge Operation. The Corporate RSO teaches radiation safety, and the District RSO teaches gauge operation. Once this is completed, candidates must pass the written and performance exams for the NAQTC Sampling and Density module. When these requirements are completed, the individual is permitted to operate and transport nuclear density gauges.

NAQTC qualification is required every five years and nuclear density gauge safety training is required every three years. After completing the 40-hour certification class, students receive a white card. After completing the 4-hour safety class, students receive a yellow card.

Every six months, Resident Engineers receive a list of personnel whose certification will be expiring and a posting of the next training class. NDOT also sends an annual reminder to certified individuals, informing them of training received and certification expiration dates.

All field testers must become familiar with basic safety procedures for the operation, storage, and transportation of the gauges. Field testers will become intimately familiar with the safety procedures for operation, storage, and transportation of the gauges. The following are a few safety reminders:

- Remember the importance of radiation safety. Three ways to limit radiation exposure effects are to reduce time exposed, keep a safe distance from the radiation source, and shield yourself.
- Post a copy of the "State of Nevada Radiological Emergency Response Plan" in each field office and field lab.
- Properly store the gauge if it is not in use.
- Do not allow non-certified individuals to operate or handle the gauges. Keep non-certified personnel at least 15 feet from the gauges.
- The Thermal Luminescent Dosimeter (TLD) or Optically Stimulated Luminescent (OSL) badges monitor the occupational dose of radiation. Leave these badges at work in the area of control badges for the crew. Do not leave badges at or near the gauges.
- If the nuclear density gauges are damaged at the jobsite, do not move anything related to the damage. Stop all operations around the site and start the emergency procedure published on the shipping papers.
- Immediately report non-routine incidents to the District RSO (Elko: 775-777-2724, Las Vegas: 702-385-6590, Reno: 775-834-8338, Winnemucca: 775-623-8075).
- When the gauge is not in operation, set the handle to the "SAFE" position.
- Always use the handle to pick up the gauge. Do not reach under the gauge to move it.
- Field testers must carry their certification cards while operating a gauge. They must also properly wear their TLD badge or OSL badge while operating or transporting a gauge.
- Always follow the proper storage, operation, and transportation procedures.
- Testers and transporters must carry the shipping papers in the truck on the seat next to the driver when the gauge is in transport. .

5-502 QUALIFICATION REQUIREMENTS**5-502.1 OPERATION AND TRANSPORTATION CERTIFICATION (WHITE CARD)**

Each first-time candidate for qualification and certification and anyone with an expired certification card must complete the following minimum requirements:

1. Attend a 40-hour training class
2. Pass a safety exam
3. Pass an operation and safety exam
4. Qualify through the NAQTC Program (Sampling and Density Module)

To maintain qualification, the individual must:

1. Attend a 4-hour safety class every three years before certification expires
2. Pass a safety exam
3. Maintain NAQTC qualification

Individuals who allow their safety card to expire must meet the same requirements as a first-time certification candidate.

5-502.2 TRANSPORTATION CERTIFICATION (YELLOW CARD)

Individuals must maintain the following minimum requirements to transport the nuclear density gauges:

1. Attend a 4-hour safety class every three years
2. Pass a Safety Exam

5-503 STORAGE AND TRANSPORTATION

The gauges are either in "storage" or in "transport" status. Permanent storage is when the gauge is located in the District storage area. Temporary storage is when a gauge is located in a field lab. The gauges cannot be in temporary storage for more than six months. If the gauge's temporary storage must extend beyond six months, the District RSO will transfer the gauge into permanent storage then transfer it back to the field lab to the temporary storage status.

When in storage, the gauges must maintain three independent physical locks: In the locked field lab; in the locked closet; and in the case provided with the gauge handle locked. Other storage requirements are:

- Notice to Employees – Place beside the outside of the closet door in the field lab.
- Radioactive Material – Place on the right side of each exterior door outside of the field lab.
- The gauges must be stored at least 15 feet from the nearest full time work station.

During transport, follow these rules:

- Strap the gauge to the truck so it cannot move more than a quarter of an inch.
- Constantly watch the gauge during transport
- Maintain the following four locks at all times:
 - Lock on gauge handle
 - Lock on case
 - Case locked to truck bed with bike lock and with locked chain
- Use the tie-down straps, which are supplied with the gauge, when the gauge is in the bed of a truck and the truck is moving.
- Whether the truck moves one foot or 10 miles, the gauge *must* be strapped down.

The United States Department of Transportation (USDOT) identifies NDOT as a "Licensee who transports gauges to and from temporary job sites." USDOT does not distinguish between local or state agencies and civilian transporters of radioactive materials. This establishes the documentation requirements for the transport of NDOT nuclear density gauges; therefore, shipping papers are required to:

- Be on the seat next to the driver when transporting or testing with a nuclear density gauge
- Be gauge specific (each set of shipping papers belongs to a particular gauge)
- Contain emergency procedures and contacts as well as radioactive material description

5-504 OPERATION

NDOT uses Troxler Nuclear Density Gauge Models 3440, 3450, and the 4640-B for conducting density and moisture tests. Find the directions for operating the gauge and taking tests in Nevada Test Methods T101, T102, T103, T104, T324, T335, T336, and T750. Gauge Models 3440, 3450, and 4640-B test density of the materials, while the 3440 and 3450 also test moisture content.

Only qualified personnel may operate the gauges. Field testers will comply with operating instructions as provided by NDOT qualification training.

NDOT provides radiation monitoring badges to all personnel qualified to transport and operate the gauges. Upon completion of the training, each qualified individual receives a badge. Personnel must wear the TLD or OSL badge between the waist and the shoulders. It must be on the torso since this type of badge measures exposure of soft tissue and internal organs.

Reminders:

- Do not allow anyone who is not certified by the Department to operate or handle the gauges.
- Make the tester's certification card easily accessible.
- Wear the radiation monitoring badge properly when transporting and operating gauges.
- Keep gauges in a safe position when not taking measurements.
- Be aware of your surroundings – avoid damage to gauges.
- Always carry gauges by the handle.

5-505 GAUGE REPAIR, MAINTENANCE, AND CALIBRATION

For repair and maintenance, nuclear density gauges require special handling by trained individuals. Transporters and operators are not authorized to provide any maintenance or repairs to the gauges. If the gauges require maintenance or repair, immediately contact the IA lab testers, who will determine the repair level. The IA lab testers located in Las Vegas, Reno, Winnemucca, and Elko may repair the nuclear density gauges as long as the sealed source does not need to be removed. If the source needs to be removed in order to repair the nuclear density gauge, then it will be sent to Carson City to the Corporate RSO for repairs. Under no circumstances will the field testers try to fix a gauge, unless directed by the Corporate RSO. Contact the Corporate RSO at 775-888-7114.

The Corporate RSO maintains and calibrates the gauges every two years. Maintenance will occur earlier if a problem exists with the gauge.

5-505.1 PERIODIC PREVENTIVE MAINTENANCE SCHEDULE

- Inspection and inventory – Twice a year, December or January, and June or July
- Leak tests – January
- Calibration – Every two years
- Source rod inspections – Every two years, or when gauge repairs are required

5-506 INSPECTIONS

Nevada Radiological Health Division enforces the proper use, storage, and transportation of nuclear devices. They will periodically inspect the program at any time and in any location. They accomplish their inspection responsibilities both announced and unannounced and may inspect field testers on the job.

For job site inspections, expect the Radiological Health Inspector to visually observe from a distance and then approach the tester to ask detailed questions to confirm the tester is following all rules, laws, and regulations. Give full cooperation to the Radiological Health Inspector. Ask the Radiological Health Inspector for a business card and identification from their authority. Follow these guidelines when working with the inspector:

- Provide your certification card for verification.
- Allow complete observation and access to documentation and records.
- Answer all questions as accurately as possible.
- Report the inspection to your District RSO immediately.

5-507 FILES AND RECORDS

The gauges are permanently stored in the District storage area. When a construction crew needs a gauge, they contact the District RSO to coordinate required duration and specific needs. The District RSO will then transfer the gauge to the construction crew and complete all the proper paperwork. The construction crew will receive the following required transport documents:

- NDOT form 040-031, "Nuclear Gauge Transfer and Packing Form"
- Shipping papers (gauge specific)
- List of emergency contacts

When the construction crew is finished with the gauge, they return the gauge with the required transport documents. If a gauge is transferred to another construction crew, then transfer documents need to be completed showing this change. The field lab and the construction crew office keep a copy of the transfer documents and send copies to the IA lab. The Corporate Radiation Safety Officer retains the original transfer document.

5-508 RADIATION EXPOSURE MONITORING

The Corporate RSO provides policy on maintaining records for the Radiation Exposure Monitoring program. The District RSO and IA lab retain the individual records for exposure badge results. The exposure that the state monitors is the Occupational Dose; therefore, it is important to maintain the badges and records at the work site.

Every quarter, the Corporate RSO issues a different color badge with a starting date for that quarter. The Corporate RSO sends the assigned badges to the field crew. The field crew assigned the badges wear them while transporting or operating the nuclear density gauges for one quarter (three months). At the end of that quarter, the Corporate RSO sends new badges to the field crew, and the field crew returns the badges from the previous quarter to the Corporate RSO.

Corporate RSO sends these badges to a testing company to determine each person's radiation exposure during that quarter. The testing company sends a report to the Corporate RSO, who then sends the report to the IA testers. The results are available to the individuals upon request.

Every District RSO receives two visitor badges every quarter. If any non-certified person will be working within 15 feet of the gauges, they will need a visitor badge assigned to them. The visitor must complete the Visitor Badge Assignment form supplied by the District RSO. This badge will be assigned to the individual for the entire quarter; however, if the individual no longer needs the badge before the quarter is over, it should be returned to the District RSO. This visitor badge cannot be assigned to any other person.

5-600 INDEPENDENT ASSURANCE PROGRAM

The Independent Assurance (IA) sampling and testing program independently verifies the reliability of the results of field sampling and acceptance testing. It also verifies contractor and state testing procedures. The IA lab, located in each District facility, is responsible for checking all projects within the District. The IA lab and its testers are not associated with the project field testers, which are under the supervision of the Resident Engineer. This assures an independent check on the field crew testing procedures. IA lab test results are not used to determine the quality and acceptability of the materials and workmanship directly.

5-601 RESPONSIBILITIES OF THE INDEPENDENT ASSURANCE TESTERS

The IA lab is responsible for auditing field testers in accordance with the "Minimum Required Samples and Tests - Independent Assurance." This consists of the following:

- Performing visual audits as well as direct splits
- Maintaining testing consistency throughout the District by verifying that NDOT's testing procedures are utilized and performed correctly by NDOT, consultant, and contractor testing personnel
- Verifying that all personnel testing on NDOT projects possess the necessary NAQTC or WAQTC and ACI qualifications
- Performing inspections on NDOT, consultant, and contractor field labs to verify that equipment meets the requirements of the test methods and is in good working condition
- Performing field lab safety inspections twice a year and completing NDOT form 040-055, "Field Lab Safety Equipment Inspection"
- Performing requirements as District RSO
- Reviewing test reports for accuracy and completeness
- Acquiring and distributing testing equipment to field testers as needed
- Providing training for the NAQTC/ACI written and performance exams and instructing NDOT's Testing School
- Assisting in yearly equipment budget request
- Providing equipment repair and maintenance

5-601.1 RELATIONS WITH FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA Area Engineers may collaborate in sampling and testing.

5-602 INDEPENDENT ASSURANCE SAMPLES AND TESTS

IA testers or field testers should perform sampling in the presence of and at the locations indicated by the IA tester. The IA tester should continually retain custody of the samples from the time they are taken until they are delivered to the IA lab.

The minimum frequency schedule in Table 5.7 (at the end of this section) outlines the materials to be sampled, sample locations, and tests to perform. When Table 5.7 allows more than one test method for a particular test, the IA testers must use the same method used by the field crew tester.

Table 5.7 also outlines the minimum frequency requirements. Use these frequencies when field testing procedures are observed to be correct (audits) and good correlation exists between the field crew and IA test results. Whenever these conditions do not exist, increase the frequency of IA samples and tests to provide greater control.

IA testers should try to sample each project uniformly throughout the construction period to avoid testing numerous samples at one time. Since sampling depends on how much material has been produced or processed since the previous sampling, IA testers should stay informed of the work on each project, organize their work, and work efficiently. For projects that are located some distance from the lab, call before leaving to eliminate wasted trips. The Resident Engineer should keep the IA lab informed of any schedule changes and coordinate testing requirements throughout the duration of the project.

At the request of the Construction Division, District Engineer, or Federal Highway Administration, the IA lab may sample and test the following items

- Compaction tests
- Concrete tests
- Specific gravity
- Deposit (pit) samples
- Any other informational tests pertaining to materials on an active or proposed project

Record these test results according to instructions in Section 5-607, Independent Assurance Files and Records.

Section 5-603, Split Samples, summarizes the typical split sample tests that the IA lab performs.

5-603 SPLIT SAMPLES

As a part of the regular IA sampling and testing program, most samples are split regularly between the field testers and the IA labs (two-way splits), or among the field testers, IA labs, or third party (three-way splits). The IA lab's test results provide an additional way to check the accuracy of the field testing procedures. Samples may also be split in other ways, such as with the contractor's lab or other field labs.

5-603.1 RESPONSIBILITY

The IA lab is responsible for administering the split sample program among the various labs. This involves supervising the sampling, splitting, and distribution of the samples and collecting and reporting the results of the tests.

5-603.2 TWO-WAY SPLITS

Two-way splits are performed on the following materials:

- Select Borrow
- Selected Material
- Granular and Drain Backfill
- Base Aggregates
- Aggregate for Treated Base
- Asphalt Treated Permeable Base
- Plantmix Bituminous Surface
- Plantmix Bituminous Open-Graded Surface
- Screenings
- Concrete Aggregates
- Aggregates for Plantmix Bituminous Surface, Open-Graded Surface, and permeable base

5-603.3 OBTAINING SAMPLES

Take split samples at the same locations as regular project samples. IA testers or field testers should sample in the presence of and at the locations indicated by the IA testers. Both the project and IA labs can use the split sample to satisfy frequency requirements of their regular project acceptance or IA samples. The sample should be large enough so that each lab will have enough material for testing according to Table 5.3, Minimum Weight of Field Samples.

5-603.4 SAMPLE PREPARATION

Split the sample with both the project and IA testers present, using an approved method, so each portion is representative of the original sample and is as similar to other portions as possible. Always use a sample splitter or quartering canvas. Carefully obtaining and preparing split samples allows for correlating testing accuracy, when comparing test results between labs. This also allows testers to quickly identify the causes of poor test result correlation.

5-603.5 TESTS PERFORMED

Split sample tests are the same tests that are run on regular project samples. Table 5.7, Minimum Required Samples and Tests – Independent Assurance (IA) (at the end of this section), lists the required tests. Labs may run other tests for informational purposes.

5-603.6 REPORTING PROCEDURES

Each field lab shall report the results of the tests performed to the corresponding IA lab. When the IA lab receives all reports, they will submit the results on a single form for comparative purposes. Be sure to submit timely field lab reports, no later than 7 days after receipt, to the IA lab so the reports include all field lab data when forwarded to the Construction Division. Report all split samples, regardless of whether they are more or less than a three-way split, to the IA lab in this manner. Refer to Section 5-607, Independent Assurance Report Forms.

5-603.7 TOLERANCES AND CORRECTIVE ACTION

When split samples vary more than the allowable tolerances shown in Table 5.6, IA Audit Tolerances, confirm that testers are following proper testing procedures. The IA lab testers will obtain and test additional split samples and perform visual audits as soon as possible, and continue this procedure until the problem is resolved. If IA lab testers cannot meet allowable tolerances with the additional audits, then the IA lab will notify the Construction Division for further action.

Table 5.6 – IA Audit Tolerances

Test	Control	Tolerance Range (Plus or Minus)
Sieve Analysis	Percent Passing 3" to 1" sieves	7%
	Percent Passing 3/4" to 3/8" sieves	6%
	Percent Passing No. 4 Sieve	5%
	Percent Passing No. 8 to No. 16 sieves	4%
	Percent Passing No. 20 to No. 50 sieves	3%
	Percent Passing No. 60 to No. 200 sieves	2%
Fractured Face	Percent Fractured Faces	7%
Sand Equivalent	Sand Equivalent Value	4%
Atterberg Limits	Plasticity Index	3
Density	Calculated Maximum Density	3 lbs/cu.ft.
Slump	Slump of Concrete	1 inch
Air Content	Percent of Air in Concrete	0.5%
Unit Weight	Pounds per cubic foot	1.5 lbs
T.M.D. (Rice)	Density	2 lbs/cu.ft.
Ignition Oven	Bitumen Ratio	0.3%

5-603.8 RECORDS

The IA lab maintains accurate records to confirm the following:

- Proper frequency of splits
- Splits are reported immediately
- Corrective action is taken when necessary
- Test documentation is maintained

Refer to Section 5-607, Independent Assurance Files and Records.

5-604 VISUAL AUDITS OF FIELD TESTING PROCEDURES

The IA lab may visually audit field sampling and testing procedures to verify the accuracy of field methods.

Audits may include the following:

1. Inspection of any or all of the following:
 - Sampling procedures
 - Sample splitting procedures
 - Sample preparation
 - Testing procedures
 - Calculations
 - Reports
 - Equipment use and procedures
 - Field books and files (lab)
2. Discussion of the audit with the individual(s) whose testing is being audited and with the Resident Engineer before leaving the job site, if corrective action is necessary.
3. Report the audit on NDOT form 040-072, "Report Form for Two Way Audits," which includes the following information:
 - Date of audit
 - Contract No.
 - Name of tester(s) audited
 - Name of auditor
 - Procedures audited
 - Remarks and recommendations
4. Verify that field lab safety procedures are being followed

A follow-up audit is required for any failing or unsatisfactory audit, visual or procedural, to verify conditions have been corrected.

5-605 INDEPENDENT ASSURANCE TESTING FREQUENCIES

Table 5.7, IA Minimum Required Samples and Tests, (at the end of this section) summarizes the requirements for sampling and testing of construction materials by Independent Assurance (IA) lab testers. The table includes the following information for each type of material or product:

- Tests that are usually performed together, with the applicable Nevada test number
- Required sampling frequency
- Required location or time that samples should be taken or tests made

Frequencies as shown are intended as the minimum requirements under normal conditions. Increase these frequencies when necessary to ensure adequate control.

The frequency schedule is a general guide for all projects. For some materials, the sampling instructions may vary according to conditions on a particular project. Not all of the tests listed for a particular type of material or product are always required. In these cases, refer to the Materials Checklist Letter to determine the applicable procedure and frequency.

5-606 INDEPENDENT ASSURANCE REPORT FORMS

Complete IA test reports daily, and distribute them to all appropriate divisions within seven days. Submit the IA test results even if the IA tester has not received the test results from the field tester. The only exception to this policy is an additional five days for two- and three-way audits. The following is a list of the report forms that the IA tester completes for various tests and audits.

- NDOT form 040-005, "Audit Report Form for Compaction Curve" – Use this form to report the field and IA moisture density curve and to report the findings of the compaction audit.
- NDOT form 040-022, "Field Lab Inspection Report" – Use this form when the IA lab inspects the field lab.
- NDOT form 040-065, "Inspection Report: Material and Testing – Project and Progress." Use this six-page form to report field and IA lab results for testing of:
 - Compaction
 - Sieve analysis
 - Flexural (beams and cylinders)
 - Cement content
 - Ignition oven

- NDOT form 040-070, "Audit Report Form for Concrete Aggregates" – Use this form to compare the approved tolerances with the results of sieve testing for concrete coarse and fine aggregates for structures and pavements by the field and IA labs.
- NDOT form 040-071, "Audit Report Form of Concrete Tests" – Use this form to compare the field and IA lab results for slump, air content, and unit weight.
- NDOT form 040-072, "Report Form for Two-way Audits" – Use this form to report the sample test results of the following materials:
 - Select borrow
 - Backfill
 - Drain backfill
 - Selected material
 - Aggregate base courses
 - Cement treated base aggregates, plantmixed and roadmixed bituminous mixtures
 - Screenings
- NDOT form 040-079, "Visual Audit Report Form" – The IA lab uses this form to report results of the field lab in the following areas:
 - Test procedures
 - Reports and files
 - Equipment
 - General lab condition
- NDOT form 040-080, "Audit Report for Absorption and Specific Gravity for Coarse and Fine Aggregates" – Use this form to compare the specific gravity and percent absorption results between the field and IA labs.
- NDOT form 040-085, "Temporary Storage of Radioactive Material Field Lab Inspection Form" – Use this form to record the results of the IA lab inspection of the field lab for security and storage of the nuclear density gauge testing equipment.
- NDOT form 040-086, "Nuclear Certified Personnel Inspection Form" – Use this form to record the results of the IA lab inspection of the procedures used by the field crew's certified field testers:
 - Shipping papers
 - Certification card
 - Monitoring device
 - Gauge secure during transportation
 - Locks
 - Gauge condition

Consecutively number the IA tests of each principal structure material for each type of material per project. Use the following information when numbering tests: District number, abbreviations (IA), and the consecutive number of the test for each type of material sampled. For example, test number 2-IA-5, indicates District Two, IA, and the fifth test for a particular project.

Consecutively number IA compaction audits and miscellaneous tests for all types of material for a particular type of project. Use the following information when numbering tests: District number, abbreviation (IA, "M" for miscellaneous tests, or the compaction materials code), and the consecutive number of the test. For example, test number 1- IA-1B-40 on a compaction audit report indicates District One, IA, Type1 Class B Aggregate, and the fortieth compaction audit for a particular project.

5-607 INDEPENDENT ASSURANCE FILES AND RECORDS

Keep all IA test worksheets and reports on file in the IA lab, and forward all original reports to the Construction Division. Staple worksheets with the IA testers' handwritten initials to each report and then file them chronologically by the type of material or audit.

Keep summaries of IA tests in a separate field book for each project. When the project is awarded to a contractor, create a summary of the number of tests and split samples to be taken. Note this information in the book for easy reference. The book is divided into four sections. The sections are described below.

5-607.1 SECTION ONE

Section one is a summary of test results for each material that has a testing frequency requirement, for example:

- Type 1 Aggregate Base
- Type 2 Aggregate Base
- Concrete Aggregate
- Cement Treated Base Aggregate
- Select Material (Base & Surface)
- Roadmix Base and Surface Aggregate
- Select Borrow
- Plantmix Bituminous Base and Surface
- Plantmix Bituminous Open-Graded Surface
- Screenings
- Backfill

Section one is divided into separate sections for each of the materials listed above. For each material test summary include the following information:

- Test number
- Date sampled
- Location of sample
- If sample is a split, indicate who the sample was split with and the corresponding test numbers
- Indicate tests run on each sample (test results not required here)

5-607.2 SECTION TWO

Section two summarizes compaction test audits. For each compaction test summary include the following information:

- District test number
- Corresponding field test number
- Type of material
- Name of individual(s) audited
- Name of auditor
- Portion or portions of test observed (in-place and/or moisture density curve)

5-607.3 SECTION THREE

Section three summarizes general audits. General audits are performed by IA testers for any sampling or testing procedure performed by field testers. Record the following information concerning the audit in section three of the field book for future reference:

- Date
- Names of individual(s) audited
- Name of auditor
- Test or procedure audited
- Remarks concerning audit and recommendations

5-607.4 SECTION FOUR

Section four summarizes audits on nonstandard tests sampled and tested by the IA testers, or special tests run at the request of the Resident Engineer, District Engineer, or FHWA personnel. For example, this section might contain compaction tests, unit weight, specific gravity, and deposit samples. Consecutively number the tests per material.

5-700 TESTING DISPUTE RESOLUTION

The section provides guidance on resolving testing disputes at the lowest level possible. All personnel must strive to solve test disputes quickly to ensure quality work with quality materials. Most testing differences can be solved in the field. Occasionally, the Construction Division or Resident Engineer may require referee testing by the Materials Division. Section 106 of the specifications describes a procedure for the contractor to follow when disputing NDOT's test results.

5-701 RESIDENT ENGINEER RESPONSIBILITY

When a test is questioned or disputed, the Resident Engineer should first conduct the test using a different tester on the same crew. If the results are still in dispute, then the Resident Engineer should immediately request an audit from the IA lab. If the IA lab audit and field test results match, then they review the results with the contractor.

If the results of the IA lab and field tester do not match, then they will perform an additional audit. This second audit will consist of the IA lab and field tester running the test side by side. Once this step has been completed, they will review audit findings and recommendations with the Resident Engineer and field testers for implementation.

If these steps do not resolve the dispute, then the Resident Engineer and IA lab will confer with the Construction Division for further guidance.

If the contractor requests independent testing or any other testing, an NDOT representative must be present during sampling and testing, as stated in Subsection 106.04 of the specifications. If the contractor provides independent testing, the Resident Engineer must notify and confer with the Materials Division.

**5-702 INDEPENDENT ASSURANCE
RESPONSIBILITY**

When tests are disputed, the IA lab must first verify testing procedures and equipment used. If no deficiencies are noted, then the IA lab will coordinate and monitor a split sample with the Resident Engineer and field tester. Once the audit is complete, the IA lab will compare and discuss the test results with the Resident Engineer and testing staff.

If the IA lab results and field results are within the allowable tolerances, they will consider field test results valid and review them with the contractor. If the IA lab results and field results do not match, then the IA lab testers and field testers will perform an additional audit, running their tests side by side. Once this step is complete, the Resident Engineer and field testers will review the audit findings and recommendations for implementation.

5-703 MATERIALS DIVISION RESPONSIBILITY

The Materials Division performs referee testing when requested by the Resident Engineer or Construction Division.

If the contractor requests independent testing or any other testing, the Materials Division will coordinate with the Resident Engineer, and all testing will be in accordance with Subsection 106.04 of the specifications.

5-704 CONTRACTOR-REQUESTED TESTING

The contractor may request to have independent testing performed. Section 106.04 of the specifications describes the procedure that the contractor must follow when disputing acceptance testing. The contractor must coordinate with the Resident Engineer before additional testing is performed.

Sampling will not begin until the Resident Engineer provides written permission. The contractor must provide the following information before receiving approval for an information test:

- Purpose of testing
- Specific tests to be performed
- Procedures proposed for sampling and testing
- Schedule of proposed sampling and testing
- Name of firm and personnel to perform the sampling and testing

5-800 ACCEPTANCE OF MATERIALS BY OTHER MEANS

Except as provided in the specifications, all materials will be inspected and tested for acceptance before being incorporated into the work. Using untested and unaccepted materials without approval or written permission runs the risk of being considered unacceptable and unauthorized and not to be paid in accordance with Section 106.04, Samples and Tests, of the specifications.

5-801 CERTIFICATES OF COMPLIANCE

Section 106.05, Certification of Compliance, of the specifications allows certain materials to be used before sampling and testing if accompanied by a Certificate of Compliance. Certificates of Compliance are a way of accepting materials before testing. A manufacturer produces a Certificate of Compliance, indicating that the material meets the specification requirements of each corresponding section of the specifications. For example, bituminous materials must be in accordance with Section 703 of the specifications.

A generic Certificate of Compliance form is available through the Materials Division and is sent to the Resident Engineer with the Materials and Sampling Checklist. Most manufacturers will have their own certificate form. A manufacturer's representative must sign and date the Certificate of Compliance, and the certificate must be legible. An original certificate is preferred, but the department may accept a copy or fax. The Resident Engineer can discuss questions about the certificate with the Materials Division.

Certificates are sent to the Materials Division using NDOT form 020-018, "Transmittal for Test Samples and Certifications." The Resident Engineer should provide a copy of the certificate to inspectors overseeing the item being incorporated into the work. The certificate is retained in the field office records. The manufacturer should also provide the Resident Engineer with any warranties, guarantees, instruction sheets, or parts lists for products incorporated into the work.

If certification of materials is delaying project completion, the Resident Engineer must notify the contractor in writing. This written notification must specify the missing certification and must inform the contractor that payment for the affected items will be deducted if it is not received within 10 working days. Send copies of this letter to the Chief Construction Engineer and the District Engineer.

The Materials Sampling and Testing Checklist that the Materials Division issues for each project identifies products and materials that may be accepted by a Certificate of Compliance. Following is a partial list of construction materials that may be accepted based on Certificates of Compliance. This list is not all-inclusive and is subject to change:

- Diesel Fuel
- Traffic Control Items
- Sign Materials
- Striping
- Guideposts/Object Markers
- Signal and Lighting
- Irrigation Systems
- Landscaping
- Water Line Systems
- Pipes and Drains
- Engineering Fabrics
- Polymer Concrete
- Precast Concrete
- Cattleguards
- Guardrail
- Barrier Systems
- Structural Steel
- Paint, Stain and Graffiti Coating
- Miscellaneous Metals
- Fencing
- Mailbox

If the contractor submits an item for use that may require a Certificate of Compliance but is not on the Materials Sampling and Testing Checklist, contact the Materials Division Lab Services for verification (775-888-7792).

5-802 ACCEPTANCE OF SMALL QUANTITIES OF CONCRETE

The Resident Engineer may approve concrete mix designs for small concrete placement quantities in the following areas and under the following conditions:

- Areas
 - Breakaway Cable Terminal (BCT) posts
 - Sign posts, excluding overhead signs
 - Fence posts
 - Curb and Gutter, up to 100 linear feet maximum
 - Other minor placements to a maximum of 1.3 cubic yards per placement
- Conditions
 - Resident Engineer may waive the trial batch requirements, if the Resident Engineer decides that the mix design is appropriate.
 - Aggregates must still come from approved sources.
 - A Resident Engineer should obtain a copy of the mix design from the concrete supplier and submit it to the Materials Division, for record only.
 - The Resident Engineer may waive any or all field tests (slump, air, unit weight, cylinders, and aggregate tests) if the Resident Engineer, after visual inspection, decides that the material is acceptable.
 - The Materials Division will assist the Resident Engineers, at their request, on any questions or concerns they may have on the acceptability of a mix design.

**5-900 OFF-SYSTEM CONTRACT
SAMPLING AND TESTING**

Off-system construction projects are divided into two basic categories: (1) those performed by the local entity forces on force account, and (2) conventional contracts awarded to a contracting firm.

The sampling and testing schedule follows Table 5.1. For off-system projects, the Resident Engineer may waive the "per day" frequencies. Discuss any changes from the frequencies shown in Table 5.1 with the Quality Assurance Engineer. All other aspects will follow procedures outlined in this manual.

5-901 STEWARDSHIP PROGRAM

Refer to Section 3-502, NDOT Stewardship for a more detailed explanation of the NDOT Stewardship Program. The assigned NDOT Resident Engineer monitors the local government's federal contract compliance responsibilities and verifies compliance with the required sampling and testing at the appropriate times and frequencies as outlined in the stewardship agreement between NDOT and the local government. NDOT's Stewardship Coordinator can provide a copy of the agreement to the Resident Engineer. The Resident Engineer coordinates with the local agency's project manager to confirm that sampling and testing requirements are scheduled and met. Following are specific procedures that the Resident Engineer monitors:

- The local agency must coordinate with the Construction Division to determine testing frequencies.
- The local agency must hire a qualified testing firm or have sufficient qualified staff to meet the established testing frequencies.
- The local agency must develop IA procedures based on the quantities and testing frequencies.
- The local agency's staff or a separate consultant from the construction administrator must implement IA procedures. Use NDOT's *Construction Manual* as a guide.
- The Construction Division must review and approve IA procedures.
- On NDOT-maintained facilities, NDOT's testing frequency and documentation must be followed per NDOT's *Construction Manual* and *Documentation Manual*.
- The local agency must maintain a summary of the tests that passed or failed, and in the case of failure, what the corrections were (for example, liquidated damages, remove and replace).
- Tester qualification (NAQTC, or WAQTC with ACI certification) is required only on stewardship projects that are on the National Highway System (NHS) or facilities that NDOT would maintain after project completion.
- NDOT's Materials Division will review and approve plantmix, open-graded, and concrete mix designs on stewardship projects that are on the state-maintained system.
- If needed, the Materials Division can provide mix design assistance. If the local agency is doing work off the State system in accordance with NDOT specifications, the Materials Division can provide assistance in making recommendations.
- The Resident Engineer will coordinate with the Materials Division on any special requirements or testing concerns.